COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 5932

Konkoly Observatory
Budapest
26 March 2010

HU ISSN 0374 – 0676

BVR$_C$I$_C$ PHOTOMETRIC EVOLUTION OF THE VERY FAST NOVA OPHIUCHI 2010 N.1 = V2673 OPH

U. MUNARI[1], S. DALLAPORTA[2]

[1] INAF Osservatorio Astronomico di Padova, Sede di Asiago, I-36032 Asiago (VI), Italy

[2] ANS Collaboration, c/o Astronomical Observatory, 36012 Asiago (VI), Italy

Nova Ophiuchi 2010 N.1 (= V2673 Oph) was discovered by H. Nishimura on Jan. 15.9 UT (cf. Nakano 2010) and confirmed spectroscopically by H. Maehara (2010) as a "Fe II" class nova.

We obtained BVR_CI_C photometry of Nova Ophiuchi 2010 N.1 with a 0.30-m Meade RCX-400 f/8 Schmidt-Cassegrain telescope equipped with a SBIG ST-9 CCD camera. The photometry was accurately corrected for color equations using nightly calibrations on Landolt (1992, 2009) standard stars. The data are presented in Table 1, and plotted in Figure 1. The combined (Poissonian + transformation) errors (always less than 0.03 mag) do not exceed the dimension of the symbols in Figure 1. The zero points of the photometry are scaled on the nearby star TYC 6260-1846-1, for which we adopted: B=11.550, V= 10.963, R_C= 10.574 and I_C= 10.222. The B and V are the values recommended by AAVSO for this star, the R_C and I_C are derived combining B, V with J,H,K from 2MASS following the recipes by Caldwell et al. (1993).

We started our observations immediately past maximum, and thus to reconstruct the whole lightcurve as presented in Figure 1, we had to integrate them with the published data.

Various estimates, based on unfiltered CCD observations secured around the time of discovery with digital cameras by Japanese amateurs, were published in CBET 2128. These observations are generally calibrated against the R_C band values of field stars as listed by the USNO catalog. We have measured the field stars around Nova Ophiuchi 2010 N.1 and found a mean $<V-R_C>$=+0.57 for them. We thus applied this shift to the unfiltered photometry of CBET 2128 and inserted it as open circles in Figure 1.

Four aproximately V-band observations were obtained by Vollmann (2010) from the green channel of color CCD images obtained with a DSLR camera. Comparison with our simultaneous photometry indicates that Vollmann values need to be corrected by +0.1 mag to be placed onto the V photometric scale. We applied such a correction and plotted the data as star symbols in Figure 1.

The VSNET organization collected some BVR_CI_C CCD photometric data of Nova Ophiuchi 2010 N.1, with observers S. Kiyota and H. Maehara (cf March 1, 2010 summary

in [vsnet-recent-nova 35402] at http://www.kusastro.kyoto-u.ac.jp/vsnet/). The data obtained by observer S. Kiyota were corrected for instrumental color equations, and are inserted in Figure 1 as asterisks. They did not require adjustments, as it also was for V band data by VSNET observer H. Maehara. The B,$R_{\rm C}$ and $I_{\rm C}$ data of the latter, however, need the application of a shift to be brought in agreement with the rest of the data. The shift we applied amounts to +0.32 mag in B, +0.34 in $R_{\rm C}$, and +0.45 mag in $I_{\rm C}$.

Table 1. Our $BVR_{\rm C}I_{\rm C}$ of Nova Oph 2010 N.1

HJD	V	$B-V$	$V-R_{\rm C}$	$V-I_{\rm C}$
2455216.7306	9.15	+0.86		+1.61
2455218.7244	9.51	+0.74		+1.68
2455223.7142	10.28	+0.69	+1.01	+1.65
2455225.7166	10.60	+0.70		+1.64
2455229.7095	10.85	+0.72	+1.00	+1.60
2455231.7104	10.90	+0.66	+1.04	+1.57
2455235.6959	11.31	+0.67	+1.13	+1.71
2455242.6834	11.79	+0.61	+1.29	+1.91
2455248.6852	12.19	+0.56	+1.49	+2.13
2455261.6320	12.91	+0.53	+1.96	+2.11
2455264.6625	12.93	+0.49	+1.89	+2.01

In Figure 1 the time is counted from maximum brightness that was reached on Jan. 18.3, 2010 at V=8.5. At that time the colors were $B-V$=+0.95, $V-R_{\rm C}$=+0.75, and $V-I_{\rm C}$=+1.50.

van den Bergh and Younger (1987) derived a mean intrinsic color $(B-V)_\circ$=+0.23 ±0.06 for novae at the time of maximum, and $(B-V)_\circ$=−0.02 ±0.04 at t_2. Comparing with $B-V$=+0.95 at maximum and $B-V$=+0.68 at t_2 from Figure 1, the reddening affecting Nova Oph 2010 N.1 is E_{B-V}=0.71, and the extinction (assuming a standard R_V=3.1 interstellar law) is therefore A_V=2.2 mag.

The light-curve in Figure 1 is characterized by a rapid rise (the last 2.2 mag in V band were covered in 3.4 days) and by a smooth decline, regulated by the decline times

$$t_2^V = 10.0 \qquad t_3^V = 23.5 \text{ days} \tag{1}$$

which are the time taken by the nova to decline, in the V band, by two and three magnitudes, respectively, from maximum brightness. These t_2^V and t_3^V values for Nova Oph 2010 are in the normal proportion found for typical novae. Given t_2^V, the Warner (1995) relation would predict t_3^V=20.8, while Munari et al. (2008) relation would give t_3^V=23.1. According to the classification of Warner (1995, his Table 5.4), a t_2^V = 10 days qualifies Nova Oph 2010 N.1 to be classed among the very fast novae.

Published relations between the absolute magnitude and the rate of decline generally take the form $M_{\rm max} = \alpha_n \log t_n + \beta_n$. Using the Cohen (1988) V-t_2 relation, the distance to the nova is 8.3 kpc, and 7.5 kpc according to the Schmidt (1957) V-t_3 relation.

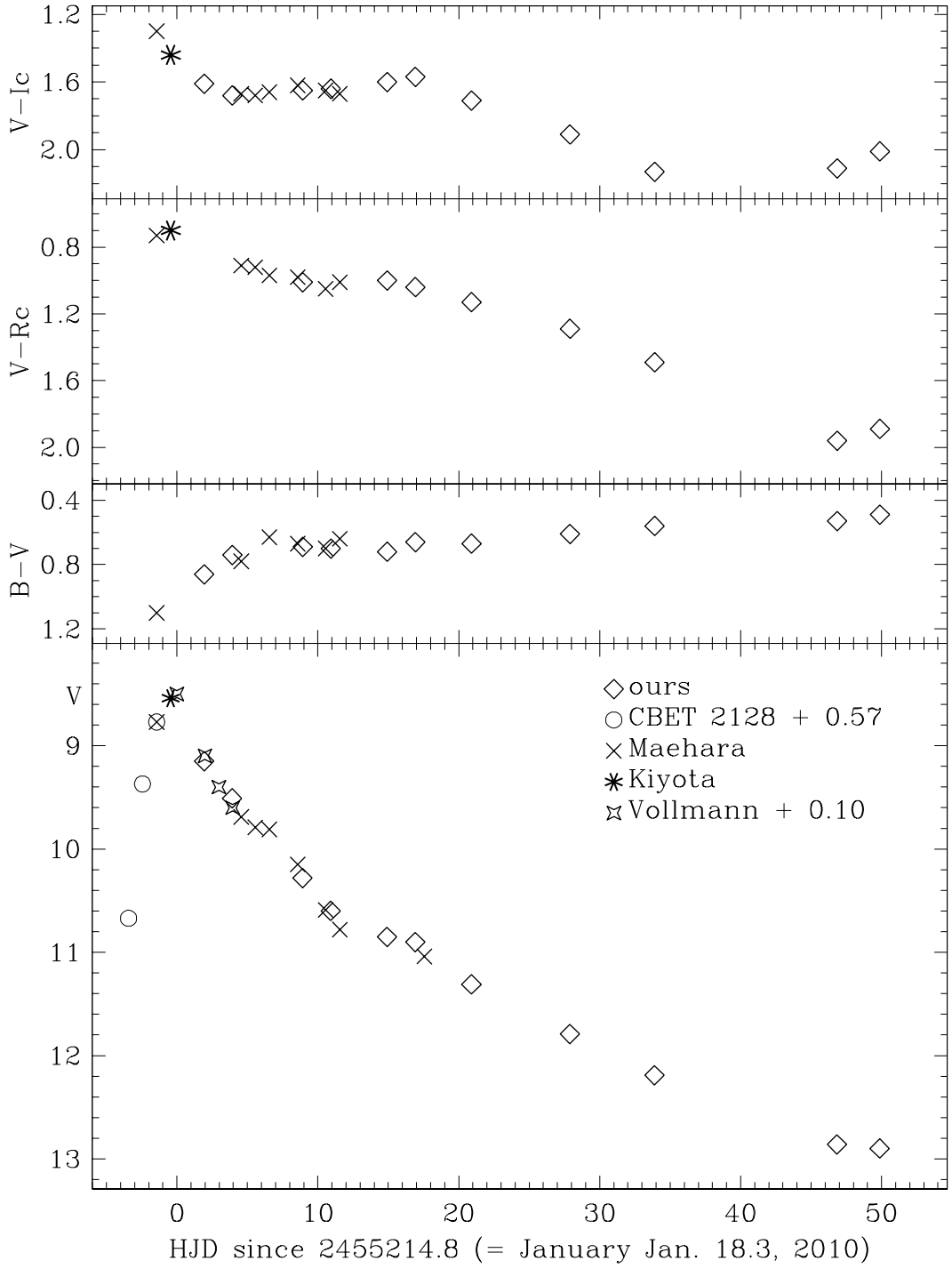

Figure 1. BVR_CI_C photometric evolution of the outburst of Nova Ophiuchi 2010 N.1. For the literature data, see text for details.

Buscombe and de Vaucouleurs (1955) suggested that all novae have the same absolute magnitude 15 days after maximum light. The mean value of the calibrations presented by Buscombe and de Vaucouleurs (1955), Cohen (1985), van den Bergh and Younger (1987), van den Bergh (1988), and Capaccioli et al. (1989) is M_{15}^{V}=−5.42±0.09, which provides a distance of 6.5 kpc to Nova Oph 2010 N.1 when compared to V_{15}=10.85 from Figure 1. Taking the mean of these three determinations, the distance to Nova Oph 2010 N.1 is d=7.4 kpc. At a galactic latitude b=4.92 deg, it corresponds to an height over the Galactic equatorial plane of z=0.6 kpc, well within the range of heights reported by della Valle and Livio (1998) for novae of the Fe II type.

References:

Buscombe, W., de Vaucouleurs, G. 1955, Obs. 75, 170
Calddwell, J.A.R., Cousins, A.W.J., Ahlers, C.C. et al. 1993, SAAO Circ. 15, 1
Capaccioli, M. et al. 1989, AJ 97, 1622
Cohen J.G. 1985, ApJ 292, 90
Cohen J.G. 1988, ASP Conf Ser 4, 114
della Valle, M., Livio, M. 1998, ApJ 506, 818
Landolt, A.U. 1992, AJ 104, 340
Landolt, A.U. 2009, AJ 137, 4186
Maehara, H. 2010, IAUC 9111
Munari, U. et al. 2008, A&A 492, 145
Nakano, S. 2010, IAUC 9111
Schmidt T. 1957, ZA 41, 182
van den Bergh, S., Younger, P.F. 1987, A&AS 70, 125
van den Bergh, S. 1988, PASP 100, 8
Vollman, W. 2010, CBET 2139
Warner B. 1995, Cataclysmic Variable Stars, Cambridge Univ. Press